MONTROSE
AIR QUALITY SERVICES

June 12, 2020

BP Products North America, Inc.
Whiting Refinery
2815 Indianapolis Blvd.
Whiting, IN 46394

Attention: Mr. Joseph Schuler

Subject: Engineering Emission Test
FCCU 500 Exhaust
BP Products North America, Inc.: Whiting, Indiana
Document No. M024AS-748176-RT-589

Dear Mr. Schuler:

Montrose Air Quality Services, LLC (Montrose) was contracted by BP Products North America, Inc. (BP) to conduct a particulate matter (PM) engineering emission test on the Fluidized Catalytic Cracking Unit (FCCU) 500 stack at their refinery located in Whiting, Indiana.

Testing was conducted on May 27, 2020 during an alternate ESP operating scenario to determine the concentrations and emission rates of total PM and PM under 10 microns (PM_{10}), including condensable PM (CPM).

Testing was conducted generally pursuant to the following procedures:

- Code of Federal Regulations, Title 40, Part 60 (40 CFR 60), Appendix A, USEPA Methods 1-4
- 40 CFR 51, Appendix M, USEPA Methods 201A and 202

Two engineering test runs were conducted with samples collected simultaneously in two Method 201A/202 sampling trains (four samples total). The first test repetition was 120 minutes in duration. The second test repetition was shortened to 90 minutes due to adverse weather that was approaching the facility.

Train A was sampled from the northwest sample port, and Train B was sampled from the southwest sample port. A full USEPA Method 1 traverse was not conducted during sampling. During each test run, the probe was traversed at the Method 1 test points across the single port in which it was inserted.

Mr. Joseph Schuler of BP coordinated the test and monitored process conditions. Testing was conducted by Mr. Steve Flaherty, Mr. Vannak Khy, Mr. Matthew Krueger, and Mr. Urbano Leos of Montrose. Mr. Steve Flaherty was the onsite field test supervisor and qualified source testing individual for the test.

The test results are presented in Tables 1 and 2. The calculation summaries, field data, and laboratory data are included in the attachments.

If you have any questions, please do not hesitate to contact me at (847) 487-1580 Ext. 12417 or sflaherty@montrose-env.com.

Respectfully submitted,

Steve Flaherty
Midwest District Manager
Montrose Air Quality Services, LLC

SF:do
Attachments

TABLE 1
FCCU 500 STACK PM_{10} AND TOTAL PM ENGINEERING TEST RESULTS (RUN 1)

TEST RUN NO. :	1-A	1-B	
TEST DATE :	5/27/2020	5/27/2020	
TEST TIME :	08:50-10:50	08:50-10:52	Average
Stack Gas Parameters			
Temperature, °F	510.9	510.0	510.5
Velocity, av. ft/sec	82.3	83.5	82.9
Volumetric flow, acfm	314,163	318,572	316,367
Volumetric flow, scfm	166,832	169,352	168,092
Volumetric flow, scfh	10,009,911	10,161,093	10,085,502
Volumetric flow, dscfm	133,017	135,060	134,038
Volumetric flow, dscfh	7,981,007	8,103,588	8,042,297
Mass flow, Mlb/hr db	644.4	654.3	649.4
Moisture, av. % vol.	20.3	20.2	20.3
Molecular weight, lb/lb-mole db	31.1	31.1	31.1
Carbon dioxide, av. % vol. db	19.0	19.0	19.0
Oxygen, av. % vol. db	1.7	1.7	1.7
Particulate Sample			
Time, min.	120.33	122.80	121.57
Volume, dscf	36.124	39.247	37.685
> PM_{10}, mg	34.75	36.45	35.60
Filterable PM_{10}, mg	127.2	129.6	128.4
Condensable PM_{10}, mg	8.40	10.85	9.63
Total PM_{10}, mg	135.6	140.5	138.0
Isokinetic ratio, %	97.9	102.7	100.3
D_{50} cutpoint, µm	10.57	10.12	10.35
Filterable PM_{10}			
Concentration			
grains/dscf	0.0543	0.0510	0.0526
x 10^{-6} lb/dscf	7.764	7.281	7.523
mg/dscm	124.351	116.617	120.484
Emission rate			
lb/hr	61.966	59.005	60.486
lb/1,000 lb coke burn	1.722	1.639	1.680
Condensable PM_{10}			
Concentration			
grains/dscf	0.0036	0.0043	0.0039
x 10^{-6} lb/dscf	0.513	0.610	0.561
mg/dscm	8.212	9.763	8.987
Emission rate			
lb/hr	4.092	4.940	4.516
lb/1,000 lb coke burn	0.114	0.137	0.125
Total PM_{10}			
Concentration			
grains/dscf	0.0579	0.0552	0.0566
x 10^{-6} lb/dscf	8.277	7.891	8.084
mg/dscm	132.563	126.380	129.471
Emission rate			
lb/hr	66.058	63.945	65.002
lb/1,000 lb coke burn	1.835	1.777	1.806

TABLE 1 (CONTINUED)
FCCU 500 STACK PM_{10} AND TOTAL PM ENGINEERING TEST RESULTS (RUN 1)

TEST RUN NO.	**:**	**1-A**	**1-B**	
TEST DATE	**:**	**5/27/2020**	**5/27/2020**	
TEST TIME	**:**	**08:50-10:50**	**08:50-10:50**	**Average**
Filterable > PM_{10}				
Concentration				
grains/dscf		0.0148	0.0143	0.0146
x 10^{-6} lb/dscf		2.121	2.048	2.085
mg/dscm		33.972	32.799	33.385
Emission rate				
lb/hr		16.929	16.595	16.762
lb/1,000 lb coke burn		0.470	0.461	0.466
Total PM (PM_{10} + > PM_{10})				
Concentration				
grains/dscf		0.0728	0.0695	0.0711
x 10^{-6} lb/dscf		10.398	9.939	10.169
mg/dscm		166.534	159.179	162.857
Emission rate				
lb/hr		82.987	80.540	81.764
lb/1,000 lb coke burn		2.306	2.238	2.272

TABLE 2
FCCU 500 STACK PM_{10} AND TOTAL PM ENGINEERING TEST RESULTS (RUN 2)

TEST RUN NO. :	2-A	2-B	
TEST DATE :	5/27/2020	5/27/2020	
TEST TIME :	12:17-13:47	12:17-13:50	Average
Stack Gas Parameters			
Temperature, °F	513.6	510.0	511.8
Velocity, av. ft/sec	82.6	84.9	83.7
Volumetric flow, acfm	315,193	324,118	319,656
Volumetric flow, scfm	166,915	172,300	169,607
Volumetric flow, scfh	10,014,892	10,337,994	10,176,443
Volumetric flow, dscfm	134,379	137,867	136,123
Volumetric flow, dscfh	8,062,711	8,272,031	8,167,371
Mass flow, Mlb/hr db	651.0	667.9	659.5
Moisture, av. % vol.	19.5	20.0	19.7
Molecular weight, lb/lb-mole db	31.1	31.1	31.1
Carbon dioxide, av. % vol. db	19.0	19.0	19.0
Oxygen, av. % vol. db	1.7	1.7	1.7
Particulate Sample			
Time, min.	90.70	93.30	92.00
Volume, dscf	27.664	29.043	28.353
> PM_{10}, mg	22.30	28.60	25.45
Filterable PM_{10}, mg	89.0	83.6	86.3
Condensable PM_{10}, mg	5.50	6.30	5.90
Total PM_{10}, mg	94.5	89.9	92.2
Isokinetic ratio, %	98.5	98.0	98.3
D_{50} cutpoint, µm	10.54	10.34	10.44
Filterable PM_{10}			
Concentration			
grains/dscf	0.0496	0.0444	0.0470
x 10^{-6} lb/dscf	7.090	6.343	6.717
mg/dscm	113.552	101.594	107.573
Emission rate			
lb/hr	57.164	52.472	54.818
lb/1,000 lb coke burn	1.589	1.458	1.523
Condensable PM_{10}			
Concentration			
grains/dscf	0.0031	0.0033	0.0032
x 10^{-6} lb/dscf	0.438	0.478	0.458
mg/dscm	7.021	7.661	7.341
Emission rate			
lb/hr	3.535	3.957	3.746
lb/1,000 lb coke burn	0.098	0.110	0.104
Total PM_{10}			
Concentration			
grains/dscf	0.0527	0.0477	0.0502
x 10^{-6} lb/dscf	7.528	6.822	7.175
mg/dscm	120.573	109.255	114.914
Emission rate			
lb/hr	60.699	56.429	58.564
lb/1,000 lb coke burn	1.687	1.568	1.628

TABLE 2 (CONTINUED)
FCCU 500 STACK PM_{10} AND TOTAL PM ENGINEERING TEST RESULTS (RUN 2)

TEST RUN NO.	**:**	**2-A**	**2-B**	
TEST DATE	**:**	**5/27/2020**	**5/27/2020**	
TEST TIME	**:**	**12:17-13:47**	**12:17-13:50**	**Average**
Filterable > PM_{10}				
Concentration				
grains/dscf		0.0124	0.0152	0.0138
x 10^{-6} lb/dscf		1.777	2.171	1.974
mg/dscm		28.468	34.777	31.622
Emission rate				
lb/hr		14.331	17.962	16.147
lb/1,000 lb coke burn		0.398	0.499	0.449
Total PM (PM_{10} + > PM_{10})				
Concentration				
grains/dscf		0.0651	0.0629	0.0640
x 10^{-6} lb/dscf		9.306	8.993	9.150
mg/dscm		149.041	144.032	146.537
Emission rate				
lb/hr		75.030	74.391	74.711
lb/1,000 lb coke burn		2.085	2.067	2.076

ATTACHMENT A
CALCULATION SUMMARIES

USEPA Method 2
Volumetric Flow Rate Sample Calculations (Circular Ducts)

Client:	BP
Location:	Whiting, IN
Source:	FCCU 500
Date:	5/27/2020
Run #:	1-A

Data Input

Carbon Dioxide (CO_2):	19.0	**%**
Oxygen (O_2):	1.7	**%**
Nitrogen (N_2):	79.3	**%**
Fractional Moisture Content (B_{wo})	0.2027	
Stack Temperature (T_s):	510.9	**°F**
Pitot Coefficient (C_p):	0.84	**dimensionless**
Average square root of ΔP	1.0605	**inches H_2O**
Barometric Pressure (P_{bar}):	29.29	**inches Hg**
Static Pressure (S_t)	-1.00	**inches H_2O**
Stack diameter:	108.00	**inches H_2O**
Stack area (A_s):	63.6172	**ft^2**

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Dry molecular weight of stack gas:

$$M_d = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2)$$ = **31.108 lb/lb-mole**

Molecular weight of stack gas, wet basis:

$$M_s = (M_d \times (1 - B_{ws})) + (18 \times B_{ws})$$ = **28.451 lb/lb-mole**

Absolute stack gas pressure:

$$P_s = P_{bar} + \left(\frac{S_t}{13.6}\right)$$ = **29.216 inches H_2O**

Stack gas velocity:

$$V_s = 85.49 \times C_p \times \sqrt{\Delta P} \times \sqrt{\frac{(T_s + 460)}{(P_s \times M_s)}}$$ = **82.305 feet/second**

Stack gas volumetric flow rate:

$$Q_a = A_s \times V_s \times 60$$ = **314,163 acfm**

Stack gas volumetric flow rate, wet basis:

$$Q_{sw} = Q_a \times \left[\left(\frac{528°R}{29.92in.Hg}\right) \times \left(\frac{P_s}{T_s + 460}\right)\right]$$ = **166,832 scfm**

$$Q_{sw} = Q_a \times \left[\left(\frac{528°R}{29.92in.Hg}\right) \times \left(\frac{P_s}{T_s + 460}\right)\right] \times 60$$ = **10,009,911 scfh**

Stack gas volumetric flow rate, dry basis:

$$Q_{std} = Q_{sw} \times (1 - B_{wo})$$ = **133,017 dscfm**

$$Q_{std} = Q_{sw} \times (1 - B_{wo}) \times 60$$ = **7,981,007 dscfh**

USEPA Method 4
Moisture Determination Sample Calculations

Client: BP
Location: Whiting, IN
Source: FCCU 500
Date: 5/27/2020
Run #: 1-A

Data Input:

Volume metered (V_m):	39.405 **ft^3**
Meter calibration coefficient (Y_d):	0.995 **dimensionless**
Barometric pressure (P_{bar}):	29.29 **inches Hg**
Meter sample rate (ΔH):	0.35 **inches H_2O**
Meter inlet/outlet temperature (T_m):	101.5 **°F**
Volume of moisture collected (V_{lc}):	195.1 **milliliters**
Stack Temperature (T_s):	510.9 **°F**
Static Pressure (St):	-1.0 **inches H_2O**

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Volume of sample, dry basis:

$$Vm_{std} = V_m \times Y_d \times \left(\frac{528.0^{\circ}R}{29.92"Hg}\right) \times \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m + 460}\right)$$

= **36.124 dscf**

Volume of water vapor in sample:

$$Vw_{std} = \frac{0.04707 ft^3}{ml} \times V_{lc}$$

= **9.183 scf**

Fractional moisture content of stack gas:

$$B_{wo} = \frac{Vw_{std}}{(Vm_{std} + Vw_{std})}$$

= **0.2027 B_{wo}**

Percent Moisture:

$$\%moisture = B_{wo} \times 100$$

= **20.27 %**

Fractional moisture content of stack gas at saturated conditions:

$$T_{s(°K)} = ((T_s - 32) * 0.5556) + 273$$

= **539.1 °Kelvin**

$$P_{s(mmHg)} = \left(P_{bar} + \frac{S_t}{13.6}\right) \times 25.401$$

= **744.00 mm Hg**

$$B_{wos} = \frac{\sqrt{\left(10^{\left(A - \left(\frac{B}{(T_{s(°K)} - C)}\right)\right)}\right)}}{P_{s(mmHg)}}$$

where:
A= 8.361
B=1893.5
C=27.65

= **1.00**

Percent moisture at saturated conditions:

$$\%moisture_{saturated} = B_{wos} \times 100$$

= **100.00 %**

Percent moisture used for emissions calculations:

= **20.27 %**

USEPA Method 201A PM_{10} Emissions
D_{50} Cutpoint Calculation Summary

Client: BP
Location: Whiting, IN
Source: FCCU 500
Date: 5/27/2020
Run #: 1-A

Data Input

Stack temperature (T_s):	510.9	**°F**
Fractional Moisture content (B_{ws}):	0.2027	
Oxygen (O_2):	1.7	**%**
Stack pressure (P_s):	29.22	**Inches Hg Abs.**
Volume metered (Vm_{std}):	36.124	**dscf**
Volume ot water vapor (Vw_{std}):	9.183	**sct**
Molecular weight of gas, wet basis (M_s):	28.451	**lb/lb-mole**
Test length (θ):	120.33	**minutes**
D_p:	10.0	**microns**

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Stack gas viscosity:

$$\mu = -150.3162 + \left(13.4622 \times \sqrt{(T_s + 460)}\right) + \left(3.86153 \times 10^{6} \times (T_s + 460)^{-2}\right) + \left(0.591123 \times (\%O_{2,\,wet})\right) - (91.9723 \times B_{ws}) + \left(1.51761 \times 10^{-5} \times B_{ws} \times (T_s + 460)^{2}\right)$$

= **258.31 micropoise**

Sample flow rate @ standard conditions:

$$Q_{sSt} = \frac{V_{mstd}}{\theta}$$

= **0.300 dscfm**

Sample flow rate through PM_{10} cyclone:

$$Q_s = \frac{29.92}{528} \times Q_{sSt} \times \left(\frac{1}{(1 - B_{ws})}\right) \times \left(\frac{[T_s + 460]}{P_s}\right)$$

= **0.709 cfm**

Calculated Reynolds Number

$$N_{re} = 8.64 \times 10^{5} \times \left(\frac{P_s \times M_s}{(T_s + 460)}\right) \times \left(\frac{Q_s}{\mu}\right)$$

= **2030**

Cunningham Correction Factor

$$C = 1 + 0.0057193 \times \left(\frac{\mu}{P_s \times D_p}\right) \times \left(\left(\frac{[T_s + 460]}{M_s}\right)^{0.50}\right)$$

= **1.0295**

D_{50} cutpoint (for Cyclone I):

$$D_{50} = \left(0.15625 \times \left(\frac{[T_s + 460]}{(M_s \times P_s)}\right)^{0.2091}\right) \times \left(\frac{\mu}{Q_s}\right)^{.7091}$$

= **10.575 µm**

USEPA Method 202
Condensible Particulate Calculation Summary

COMPANY: BP
LOCATION: Whiting, IN
SOURCE: FCCU 500
TEST DATE: 5/27/20
RUN NUMBER: 1-A

Data Input:

V_m:	39.405	ft^3	Q_s:	133,017	dscfm
γ FACTOR:	0.995		T_s:	510.9	°F
P_{bar}:	29.29	in.Hg	Runtime:	120.33	minutes
ΔH:	0.35	$in.H_2O$	V_s:	82.305	ft/sec
T_m:	101.5	°F	P_s:	29.22	in.Hg
V_{lc}:	195.1	mL	Noz. diam:	0.164	inches
N:	0.0000		m_{ib}:	0.00	mg
V_t:	0.00	mL	m_{ob}:	0.00	mg
m_r:	6.80	mg			
m_o:	1.60	mg			

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Volume of sample at standard conditions:

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 36.124 \text{ dscf}$$

Mass of ammonia correction:

$$m_c = 17.03 \times V_T \times N = 0.00 \text{ mg}$$

Mass of the field blank:

$$m_{fb} = m_{ib} + m_{ob} = 0.00 \text{ mg}$$

Mass of inorganic condensible PM:

$$m_i = m_r - m_c = 6.80 \text{ mg}$$

Total mass of condensible PM:

$$m_{cpm} = m_i + m_o - m_{fb} = 8.40 \text{ mg}$$

USEPA Method 201A PM_{10} Emissions
Particulate Calculation Summary

Client:	BP
Location:	Whiting, IN
Source:	FCCU 500
Date:	5/27/2020
Run #:	1-A

Data Input

Barometric pressure (P_{bar}):	29.29	**inches Hg**	**Particulate Weight:**	
Stack pressure (P_s):	29.22	**inches Hg Abs.**	**<PM10 (Filterable)**	113.55 **milligrams**
Test length (θ):	120.33	**minutes**	**>PM10 (Cyclone Catch)**	34.75 **milligrams**
Sample nozzle diameter (D_n):	0.1640	**inches**		
Sample nozzle area (A_n):	0.000147	**ft^3**	**<PM10 (Probe Wash)**	13.65 **milligrams**
Stack temperature (T_s):	510.9	**°F**	**Total PM_{10} front half:**	127.20 **milligrams**
Volume metered (Vm_{std}):	36.124	**ft^3**		
Stack gas velocity (V_s):	82.305	**feet/second**	**Total PM front half**	161.95 **milligrams**
Stack gas volumetric flow (Q_{std}):	7,981,007	**dsct/hour**	**Total corrected PM_{10} back half:**	8.40 **milligrams**
Fractional moisture content (B_{wo}):	0.2027			
Coke Burn Rate (R_c):	35,993	**lb/hr**	**Total PM_{10} weight (M_n):**	135.60 **milligrams**
			Total PM weight (M_n):	170.35 **milligrams (>PM_{10} + PM_{10})**

Sample calculations @ standard conditions (29.92 inches Hg, 88.0 °F):

Percent Isokinetic:

$$\%\text{Isokinetic} = \frac{0.0945 \times Vm_{std} \times (T_s + 460)}{P_s \times V_s \times \theta \times A_n \times (1 - B_{wo})}$$

= **97.9 % isokinetic**

PM_{10} and Total Particulate emission rate (lb/dscf):

$$C_s = \frac{\left(\frac{0.01543\,\text{grains}}{\text{mg}} \times M_n\right)}{V_{mstd}}$$

= **0.0728 total PM gr/dscf**
= **0.0148 >PM_{10} gr/dscf**
= **0.0543 filterable PM_{10} gr/dscf**
= **0.0036 condensible PM_{10} gr/dscf**
= **0.0579 PM_{10} gr/dscf**

$$C_s = \frac{M_n}{V_{mstd}} \times \frac{35.315\,ft^3}{m^3}$$

= **166.634 total PM mg/dscm**
= **33.972 >PM_{10} mg/dscm**
= **124.351 filterable PM_{10} mg/dscm**
= **8.212 condensible PM_{10} mg/dscm**
= **132.563 PM_{10} mg/dscm**

$$E_p = \frac{\left(\frac{2.205 \times 10^{-6}\,\text{lb}}{\text{mg}} \times M_n\right)}{V_{mstd}}$$

= **10.398 x 10^{-6} total PM lb/dscf**
= **2.121 x 10^{-6} >PM_{10} lb/dscf**
= **7.764 x 10^{-6} filterable PM_{10} lb/dscf**
= **0.513 x 10^{-6} condensible PM_{10} lb/dscf**
= **8.277 x 10^{-6} PM_{10} lb/dscf**

PM_{10} and Total Particulate emission rate (lb/hr):

$$E_p = C^1_s \times Q_{std}$$

= **82.987 total PM lb/hr**
= **16.929 >PM_{10} lb/hr**
= **61.966 filterable PM_{10} lb/hr**
= **4.092 condensible PM_{10} lb/hr**
= **66.058 PM_{10} lb/hr**

$$pmr_{lb/1000lb\,coke\,burn} = \frac{(E_p)(1000)}{(R_c)}$$

= **2.306 total PM lb/1000lb coke burn**
= **0.470 >PM_{10} lb/1000lb coke burn**
= **1.722 filterable PM_{10} lb/1000lb coke burn**
= **0.114 condensible PM_{10} lb/1000 coke burn**
= **1.836 PM_{10} lb/1000 coke burn**

USEPA Method 2
Volumetric Flow Rate Sample Calculations (Circular Ducts)

Client:	BP
Location:	Whiting, IN
Source:	FCCU 500
Date:	5/27/2020
Run #:	1-B

Data Input

Carbon Dioxide (CO_2):	19.0	**%**
Oxygen (O_2):	1.7	**%**
Nitrogen (N_2):	79.3	**%**
Fractional Moisture Content (B_{wo})	0.2025	
Stack Temperature (T_s):	510.0	**°F**
Pitot Coefficient (C_p):	0.84	**dimensionless**
Average square root of ΔP	1.0760	**inches H_2O**
Barometric Pressure (P_{bar}):	29.29	**inches Hg**
Static Pressure (S_t)	-0.95	**inches H_2O**
Stack diameter:	108.00	**inches H_2O**
Stack area (A_s):	63.6172	**ft^2**

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Dry molecular weight of stack gas:

$$M_d = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2)$$ = **31.108 lb/lb-mole**

Molecular weight of stack gas, wet basis:

$$M_s = (M_d \times (1 - B_{ws})) + (18 \times B_{ws})$$ = **28.454 lb/lb-mole**

Absolute stack gas pressure:

$$P_s = P_{bar} + \left(\frac{S_t}{13.6}\right)$$ = **29.220 inches H_2O**

Stack gas velocity:

$$V_s = 85.49 \times C_p \times \sqrt{\Delta P} \times \sqrt{\frac{(T_s + 460)}{(P_s \times M_s)}}$$ = **83.461 feet/second**

Stack gas volumetric flow rate:

$$Q_a = A_s \times V_s \times 60$$ = **318,572 acfm**

Stack gas volumetric flow rate, wet basis:

$$Q_{sw} = Q_a \times \left[\left(\frac{528°R}{29.92in.Hg}\right) \times \left(\frac{P_s}{T_s + 460}\right)\right]$$ = **169,352 scfm**

$$Q_{sw} = Q_a \times \left[\left(\frac{528°R}{29.92in.Hg}\right) \times \left(\frac{P_s}{T_s + 460}\right)\right] \times 60$$ = **10,161,093 scfh**

Stack gas volumetric flow rate, dry basis:

$$Q_{std} = Q_{sw} \times (1 - B_{wo})$$ = **135,060 dscfm**

$$Q_{std} = Q_{sw} \times (1 - B_{wo}) \times 60$$ = **8,103,588 dscfh**

USEPA Method 4
Moisture Determination Sample Calculations

Client:	BP
Location:	Whiting, IN
Source:	FCCU 500
Date:	5/27/2020
Run #:	1-B

Data Input:

Volume metered (V_m):	42.506	**ft^3**
Meter calibration coefficient (Y_d):	1.009	**dimensionless**
Barometric pressure (P_{bar}):	29.29	**inches Hg**
Meter sample rate (ΔH):	0.32	**inches H_2O**
Meter inlet/outlet temperature (T_m):	105.3	**°F**
Volume of moisture collected (V_{lc}):	211.7	**milliliters**
Stack Temperature (T_s):	510.0	**°F**
Static Pressure (St):	-1.0	**inches H_2O**

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Volume of sample, dry basis:

$$Vm_{std} = V_m \times Y_d \times \left(\frac{528.0°R}{29.92"Hg}\right) \times \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m + 460}\right)$$ = **39.247 dscf**

Volume of water vapor in sample:

$$Vw_{std} = \frac{0.04707 ft^3}{ml} \times V_{lc}$$ = **9.965 scf**

Fractional moisture content of stack gas:

$$B_{wo} = \frac{Vw_{std}}{(Vm_{std} + Vw_{std})}$$ = **0.2025 B_{wo}**

Percent Moisture:

$$\%moisture = B_{wo} \times 100$$ = **20.25 %**

Fractional moisture content of stack gas at saturated conditions:

$$T_{s(°K)} = ((T_s - 32) * 0.5556) + 273$$ = **538.6 °Kelvin**

$$P_{s(mmHg)} = \left(P_{bar} + \frac{S_t}{13.6}\right) \times 25.401$$ = **744.00 mm Hg**

$$B_{wos} = \frac{\sqrt{\left(10^{\left(A - \left(\frac{B}{(T_{s(°K)} - C)}\right)\right)}\right)}}{P_{s(mmHg)}}$$

where:
A= 8.361
B=1893.5
C=27.65

= **1.00**

Percent moisture at saturated conditions:

$$\%moisture_{saturated} = B_{wos} \times 100$$ = **100.00 %**

Percent moisture used for emissions calculations:

= **20.25 %**

USEPA Method 201A PM_{10} Emissions
D_{50} Cutpoint Calculation Summary

Client:	BP
Location:	Whiting, IN
Source:	FCCU 500
Date:	5/27/2020
Run #:	1-B

Data Input

Stack temperature (T_s):	510.0	**°F**
Fractional Moisture content (B_{ws}):	0.2025	
Oxygen (O_2):	1.7	**%**
Stack pressure (P_s):	29.22	**Inches Hg Abs.**
Volume metered (Vm_{std}):	39.247	**dscf**
Volume of water vapor (Vw_{std}):	9.965	**sct**
Molecular weight of gas, wet basis (M_s):	28.454	**lb/lb-mole**
Test length (θ):	122.80	**minutes**
D_p:	10.0	**microns**

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Stack gas viscosity:

$$\mu = -150.3162 + \left(13.4622 \times \sqrt{(T_s + 460)}\right) + \left(3.86153 \times 10^{6} \times (T_s + 460)^{-2}\right) + \left(0.591123 \times (\%O_{2,\,wet})\right) - (91.9723 \times B_{ws}) + \left(1.51761 \times 10^{-5} \times B_{ws} \times (T_s + 460)^{2}\right)$$

= **258.1 micropoise**

Sample flow rate @ standard conditions:

$$Q_{sSt} = \frac{V_{mstd}}{\theta}$$

= **0.320 dscfm**

Sample flow rate through PM_{10} cyclone:

$$Q_s = \frac{29.92}{528} \times Q_{sSt} \times \left(\frac{1}{(1 - B_{ws})}\right) \times \left(\frac{[T_s + 460]}{P_s}\right)$$

= **0.754 cfm**

Calculated Reynolds Number

$$N_{re} = 8.64 \times 10^{5} \times \left(\frac{P_s \times M_s}{(T_s + 460)}\right) \times \left(\frac{Q_s}{\mu}\right)$$

= **2163**

Cunningham Correction Factor

$$C = 1 + 0.0057193 \times \left(\frac{\mu}{P_s \times D_p}\right) \times \left(\left(\frac{[T_s + 460]}{M_s}\right)^{0.50}\right)$$

= **1.030**

D_{50} cutpoint (for Cyclone I):

$$D_{50} = \left(0.15625 \times \left(\frac{[T_s + 460]}{(M_s \times P_s)}\right)^{0.2091}\right) \times \left(\frac{\mu}{Q_s}\right)^{.7091}$$

= **10.118 µm**

USEPA Method 202
Condensible Particulate Calculation Summary

COMPANY: BP
LOCATION: Whiting, IN
SOURCE: FCCU 500
TEST DATE: 5/27/20
RUN NUMBER: 1-B

Data Input:

V_m:	42.506	ft^3	Q_s:	135,060	dscfm
γ FACTOR:	1.009		T_s:	510.0	°F
P_{bar}:	29.29	in.Hg	Runtime:	122.80	minutes
ΔH:	0.32	$in.H_2O$	V_s:	83.461	ft/sec
T_m:	105.3	°F	P_s:	29.22	in.Hg
V_{lc}:	211.7	mL	Noz. diam:	0.164	inches
N:	0.0000		m_{ib}:	0.00	mg
V_t:	0.23	mL	m_{ob}:	0.00	mg
m_r:	9.35	mg			
m_o:	1.50	mg			

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Volume of sample at standard conditions:

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 39.247 \text{ dscf}$$

Mass of ammonia correction:

$$m_c = 17.03 \times V_T \times N = 0.00 \text{ mg}$$

Mass of the field blank:

$$m_{fb} = m_{ib} + m_{ob} = 0.00 \text{ mg}$$

Mass of inorganic condensible PM:

$$m_i = m_r - m_c = 9.35 \text{ mg}$$

Total mass of condensible PM:

$$m_{cpm} = m_i + m_o - m_{fb} = 10.85 \text{ mg}$$

USEPA Method 201A PM10 Emissions
Particulate Calculation Summary

Client:	BP
Location:	Whiting, IN
Source:	FCCU 500
Date:	5/27/2020
Run #:	1-B

Data Input

Barometric pressure (P_{bar}):	29.29 **inches Hg**	**Particulate Weight:**	
Stack pressure (P_s):	29.22 **Inches Hg Abs.**	**<PM10 (Filterable)**	118.50 **milligrams**
Test length (θ):	122.80 **minutes**	**>PM10 (Cyclone Catch)**	36.45 **milligrams**
Sample nozzle diameter (D_n):	0.1640 **inches**		
Sample nozzle area (A_n):	0.000147 **ft²**	**<PM10 (Probe Wash)**	11.10 **milligrams**
Stack temperature (T_s):	510.0 **°F**	**Total PM_{10} front half:**	129.60 **milligrams**
Volume metered (Vm_{std}):	39.247 **ft³**		
Stack gas velocity (V_s):	83.461 **feet/second**	**Total PM front half**	166.05 **milligrams**
Stack gas volumetric flow (Q_{std}):	8,103,588 **dscf/hour**	**Total corrected PM_{10} back half:**	10.85 **milligrams**
Fractional Moisture content (B_{wo}):	0.2025		
Coke Burn Rate (R_c):	35,993 **lb/hr**	**Total PM_{10} weight (M_n):**	140.45 **milligrams**
		Total PM weight (M_n):	176.90 **milligrams (>PM_{10} + PM_{10})**

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Percent Isokinetic:

$$\%Isokinetic = \frac{0.0945 \times Vm_{std} \times (T_s + 460)}{P_s \times V_s \times \theta \times A_n \times (1 - B_{wo})}$$

= **102.7 % isokinetic**

PM_{10} and Total Particulate emission rate (lb/dscf):

$$C_s = \frac{\left(\frac{0.01543 grains}{mg} \times M_n\right)}{V_{mstd}}$$

= **0.0695 total PM gr/dscf**
= **0.0143 >PM_{10} gr/dscf**
= **0.0510 filterable PM_{10} gr/dscf**
= **0.0043 condensible PM_{10} gr/dscf**
= **0.0552 PM_{10} gr/dscf**

$$C_s = \frac{M_n}{V_{mstd}} \times \frac{35.315 ft^3}{m^3}$$

= **159.179 total PM mg/dscm**
= **32.799 >PM_{10} mg/dscm**
= **116.617 filterable PM_{10} mg/dscm**
= **9.763 condensible PM_{10} mg/dscm**
= **126.380 PM_{10} mg/dscm**

$$E_p = \frac{\left(\frac{2.205 \times 10^{-6} lb}{mg} \times M_n\right)}{V_{mstd}}$$

= **9.939 x 10^{-6} total PM lb/dscf**
= **2.048 x 10^{-6} >PM_{10} lb/dscf**
= **7.281 x 10^{-6} filterable PM_{10} lb/dscf**
= **0.610 x 10^{-6} condensible PM_{10} lb/dscf**
= **7.891 x 10^{-6} PM_{10} lb/dscf**

PM_{10} and Total Particulate emission rate (lb/hr):

$$E_p = C'_s \times Q_{std}$$

= **80.540 total PM lb/hr**
= **16.595 >PM_{10} lb/hr**
= **59.005 filterable PM_{10} lb/hr**
= **4.940 condensible PM_{10} lb/hr**
= **63.945 PM_{10} lb/hr**

$$pmr_{lb/1000lb\ coke\ burn} = \frac{(E_p)(1000)}{(R_c)}$$

= **2.238 total PM lb/1000lb coke burn**
= **0.461 >PM_{10} lb/1000lb coke burn**
= **1.639 filterable PM_{10} lb/1000lb coke burn**
= **0.137 condensible PM_{10} lb/1000 coke burn**
= **1.777 PM_{10} lb/1000 coke burn**

USEPA Method 2
Volumetric Flow Rate Sample Calculations (Circular Ducts)

Client: BP
Location: Whiting, IN
Source: FCCU 500
Date: 5/27/2020
Run #: 2-A

Data Input

Carbon Dioxide (CO_2):	19.0	**%**
Oxygen (O_2):	1.7	**%**
Nitrogen (N_2):	79.3	**%**
Fractional Moisture Content (B_{wo})	0.1949	
Stack Temperature (T_s):	513.6	**°F**
Pitot Coefficient (C_p):	0.84	**dimensionless**
Average square root of ΔP	1.0644	**inches H_2O**
Barometric Pressure (P_{bar}):	29.29	**inches Hg**
Static Pressure (S_t)	-1.00	**inches H_2O**
Stack diameter:	108.00	**inches H_2O**
Stack area (A_s):	63.6172	**ft^2**

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Dry molecular weight of stack gas:

$$M_d = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2)$$ = **31.108 lb/lb-mole**

Molecular weight of stack gas, wet basis:

$$M_s = (M_d \times (1 - B_{ws})) + (18 \times B_{ws})$$ = **28.553 lb/lb-mole**

Absolute stack gas pressure:

$$P_s = P_{bar} + \left(\frac{S_t}{13.6}\right)$$ = **29.216 inches H_2O**

Stack gas velocity:

$$V_s = 85.49 \times C_p \times \sqrt{\Delta P} \times \sqrt{\frac{(T_s + 460)}{(P_s \times M_s)}}$$ = **82.575 feet/second**

Stack gas volumetric flow rate:

$$Q_a = A_s \times V_s \times 60$$ = **315,193 acfm**

Stack gas volumetric flow rate, wet basis:

$$Q_{sw} = Q_a \times \left[\left(\frac{528°R}{29.92in.Hg}\right) \times \left(\frac{P_s}{T_s + 460}\right)\right]$$ = **166,915 scfm**

$$Q_{sw} = Q_a \times \left[\left(\frac{528°R}{29.92in.Hg}\right) \times \left(\frac{P_s}{T_s + 460}\right)\right] \times 60$$ = **10,014,892 scfh**

Stack gas volumetric flow rate, dry basis:

$$Q_{std} = Q_{sw} \times (1 - B_{wo})$$ = **134,379 dscfm**

$$Q_{std} = Q_{sw} \times (1 - B_{wo}) \times 60$$ = **8,062,711 dscfh**

USEPA Method 4
Moisture Determination Sample Calculations

Client: BP
Location: Whiting, IN
Source: FCCU 500
Date: 5/27/2020
Run #: 2-A

Data Input:

Volume metered (V_m):	30.180	**ft^3**
Meter calibration coefficient (Y_d):	0.995	**dimensionless**
Barometric pressure (P_{bar}):	29.29	**inches Hg**
Meter sample rate (ΔH):	0.37	**inches H_2O**
Meter inlet/outlet temperature (T_m):	101.6	**°F**
Volume of moisture collected (V_{lc}):	142.3	**milliliters**
Stack Temperature (T_s):	513.6	**°F**
Static Pressure (St):	-1.0	**inches H_2O**

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Volume of sample, dry basis:

$$Vm_{std} = V_m \times Y_d \times \left(\frac{528.0°R}{29.92"Hg}\right) \times \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m + 460}\right)$$ = **27.664 dscf**

Volume of water vapor in sample:

$$Vw_{std} = \frac{0.04707 ft^3}{ml} \times V_{lc}$$ = **6.698 scf**

Fractional moisture content of stack gas:

$$B_{wo} = \frac{Vw_{std}}{(Vm_{std} + Vw_{std})}$$ = **0.1949 B_{wo}**

Percent Moisture:

$$\%moisture = B_{wo} \times 100$$ = **19.49 %**

Fractional moisture content of stack gas at saturated conditions:

$$T_{s(°K)} = ((T_s - 32) * 0.5556) + 273$$ = **540.6 °Kelvin**

$$P_{s(mmHg)} = \left(P_{bar} + \frac{S_t}{13.6}\right) \times 25.401$$ = **744.00 mm Hg**

$$B_{wos} = \frac{\sqrt{\left(10^{\left(A - \left(\frac{B}{(T_{s(°K)} - C)}\right)\right)}\right)}}{P_{s(mmHg)}}$$

where:
A= 8.361
B=1893.5
C=27.65

= **1.00**

Percent moisture at saturated conditions:

$$\%moisture_{saturated} = B_{wos} \times 100$$ = **100.00 %**

Percent moisture used for emissions calculations:

= **19.49 %**

USEPA Method 201A PM_{10} Emissions
D_{50} Cutpoint Calculation Summary

Client:	BP
Location:	Whiting, IN
Source:	FCCU 500
Date:	5/27/2020
Run #:	2-A

Data Input

Stack temperature (T_s):	513.6	**°F**
Fractional Moisture content (B_{ws}):	0.1949	
Oxygen (O_2):	1.7	**%**
Stack pressure (P_s):	29.22	**Inches Hg Abs.**
Volume metered (Vm_{std}):	27.664	**dscf**
Volume of water vapor (Vw_{std}):	6.698	**scf**
Molecular weight of gas, wet basis (M_s):	28.553	**lb/lb-mole**
Test length (θ):	90.70	**minutes**
D_p:	10.0	**microns**

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Stack gas viscosity:

$$\mu = -150.3162 + \left(13.4622 \times \sqrt{(T_s + 460)}\right) + \left(3.86153 \times 10^{6} \times (T_s + 460)^{-2}\right) + \left(0.591123 \times (\%O_{2,\,wet})\right) - (91.9723 \times B_{ws}) + \left(1.51761 \times 10^{-5} \times B_{ws} \times (T_s + 460)^{2}\right)$$

= **259.50 micropoise**

Sample flow rate @ standard conditions:

$$Q_{sSt} = \frac{V_{mstd}}{\theta}$$

= **0.305 dscfm**

Sample flow rate through PM_{10} cyclone:

$$Q_s = \frac{29.92}{528} \times Q_{sSt} \times \left(\frac{1}{(1 - B_{ws})}\right) \times \left(\frac{[T_s + 460]}{P_s}\right)$$

= **0.715 cfm**

Calculated Reynolds Number

$$N_{re} = 8.64 \times 10^{5} \times \left(\frac{P_s \times M_s}{(T_s + 460)}\right) \times \left(\frac{Q_s}{\mu}\right)$$

= **2041**

Cunningham Correction Factor

$$C = 1 + 0.0057193 \times \left(\frac{\mu}{P_s \times D_p}\right) \times \left(\left(\frac{[T_s + 460]}{M_s}\right)^{0.50}\right)$$

= **1.0297**

D_{50} cutpoint (for Cyclone I):

$$D_{50} = \left(0.15625 \times \left(\frac{[T_s + 460]}{(M_s \times P_s)}\right)^{0.2091}\right) \times \left(\frac{\mu}{Q_s}\right)^{.7091}$$

= **10.540 µm**

USEPA Method 202
Condensible Particulate Calculation Summary

COMPANY: BP
LOCATION: Whiting, IN
SOURCE: FCCU 500
TEST DATE: 5/27/20
RUN NUMBER: 2-A

Data Input:

V_m:	30.180	ft^3	Q_s:	134,379	dscfm
γ FACTOR:	0.995		T_s:	513.6	°F
P_{bar}:	29.29	in.Hg	Runtime:	90.70	minutes
ΔH:	0.37	$in.H_2O$	V_s:	82.575	ft/sec
T_m:	101.6	°F	P_s:	29.22	in.Hg
V_{lc}:	142.3	mL	Noz. diam:	0.164	inches
N:	0.0000		m_{ib}:	0.00	mg
V_t:	0.00	mL	m_{ob}:	0.00	mg
m_r:	4.70	mg			
m_o:	0.80	mg			

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Volume of sample at standard conditions:

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 27.664 \text{ dscf}$$

Mass of ammonia correction:

$$m_c = 17.03 \times V_T \times N = 0.00 \text{ mg}$$

Mass of the field blank:

$$m_{fb} = m_{ib} + m_{ob} = 0.00 \text{ mg}$$

Mass of inorganic condensible PM:

$$m_i = m_r - m_c = 4.70 \text{ mg}$$

Total mass of condensible PM:

$$m_{cpm} = m_i + m_o - m_{fb} = 5.50 \text{ mg}$$

USEPA Method 201A PM_{10} Emissions
Particulate Calculation Summary

Client: BP
Location: Whiting, IN
Source: FCCU 500
Date: 5/27/2020
Run #: 2-A

Data Input

Barometric pressure (P_{bar}):	29.29	**inches Hg**	**Particulate Weight:**	
Stack pressure (P_s):	29.22	**inches Hg Abs.**	**<PM10 (Filterable)**	83.80 **milligrams**
Test length (θ):	90.70	**minutes**	**>PM10 (Cyclone Catch)**	22.30 **milligrams**
Sample nozzle diameter (D_n):	0.1640	**inches**		
Sample nozzle area (A_n):	0.000147	**ft^3**	**<PM10 (Probe Wash)**	5.15 **milligrams**
Stack temperature (T_s):	513.6	**°F**	**Total PM_{10} front half:**	88.95 **milligrams**
Volume metered (Vm_{std}):	27.664	**ft^3**		
Stack gas velocity (V_s):	82.575	**feet/second**	**Total PM front half**	111.25 **milligrams**
Stack gas volumetric flow (Q_{std}):	8,062,711	**dscf/hour**	**Total corrected PM_{10} back half:**	5.50 **milligrams**
Fractional moisture content (B_{wo}):	0.1949			
Coke Burn Rate (R_c):	35,986	**lb/hr**	**Total PM_{10} weight (M_n):**	94.45 **milligrams**
			Total PM weight (M_n):	116.75 **milligrams (>PM_{10} + PM_{10})**

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Percent Isokinetic:

$$\%Isokinetic = \frac{0.0945 \times Vm_{std} \times (T_s + 460)}{P_s \times V_s \times \theta \times A_n \times (1 - B_{wo})}$$

= **98.5 % isokinetic**

PM_{10} and Total Particulate emission rate (lb/dscf):

$$C_s = \frac{\left(\frac{0.01543 grains}{mg} \times M_n\right)}{V_{mstd}}$$

= **0.0651 total PM gr/dscf**
= **0.0124 >PM_{10} gr/dscf**
= **0.0496 filterable PM_{10} gr/dscf**
= **0.0031 condensible PM_{10} gr/dscf**
= **0.0527 PM_{10} gr/dscf**

$$C_s = \frac{M_n}{V_{mstd}} \times \frac{35.315 ft^3}{m^3}$$

= **149.041 total PM mg/dscm**
= **28.468 >PM_{10} mg/dscm**
= **113.552 filterable PM_{10} mg/dscm**
= **7.021 condensible PM_{10} mg/dscm**
= **120.573 PM_{10} mg/dscm**

$$E_p = \frac{\left(\frac{2.205 \times 10^{-6} lb}{mg} \times M_n\right)}{V_{mstd}}$$

= **9.306 x 10^{-6} total PM lb/dscf**
= **1.777 x 10^{-6} >PM_{10} lb/dscf**
= **7.090 x 10^{-6} filterable PM_{10} lb/dscf**
= **0.438 x 10^{-6} condensible PM_{10} lb/dscf**
= **7.528 x 10^{-6} PM_{10} lb/dscf**

PM_{10} and Total Particulate emission rate (lb/hr):

$$E_p = C^1_s \times Q_{std}$$

= **75.030 total PM lb/hr**
= **14.331 >PM_{10} lb/hr**
= **57.164 filterable PM_{10} lb/hr**
= **3.535 condensible PM_{10} lb/hr**
= **60.699 PM_{10} lb/hr**

$$pmr_{lb/1000lb\ coke\ burn} = \frac{(E_p)(1000)}{(R_c)}$$

= **2.085 total PM lb/1000lb coke burn**
= **0.398 >PM_{10} lb/1000lb coke burn**
= **1.589 filterable PM_{10} lb/1000lb coke burn**
= **0.098 condensible PM_{10} lb/1000 coke burn**
= **1.687 PM_{10} lb/1000 coke burn**

USEPA Method 2
Volumetric Flow Rate Sample Calculations (Circular Ducts)

Client: BP
Location: Whiting, IN
Source: FCCU 500
Date: 5/27/2020
Run #: 2-B

Data Input

Carbon Dioxide (CO_2):	19.0	**%**
Oxygen (O_2):	1.7	**%**
Nitrogen (N_2):	79.3	**%**
Fractional Moisture Content (B_{wo})	0.1998	
Stack Temperature (T_s):	510.0	**°F**
Pitot Coefficient (C_p):	0.84	**dimensionless**
Average square root of ΔP	1.0954	**inches H_2O**
Barometric Pressure (P_{bar}):	29.29	**inches Hg**
Static Pressure (S_t)	-0.95	**inches H_2O**
Stack diameter:	108.00	**inches H_2O**
Stack area (A_s):	63.6172	**ft^2**

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Dry molecular weight of stack gas:

$$M_d = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + (0.28 \times \%N_2)$$ = **31.108 lb/lb-mole**

Molecular weight of stack gas, wet basis:

$$M_s = (M_d \times (1 - B_{ws})) + (18 \times B_{ws})$$ = **28.488 lb/lb-mole**

Absolute stack gas pressure:

$$P_s = P_{bar} + \left(\frac{S_t}{13.6}\right)$$ = **29.220 inches H_2O**

Stack gas velocity:

$$V_s = 85.49 \times C_p \times \sqrt{\Delta P} \times \sqrt{\frac{(T_s + 460)}{(P_s \times M_s)}}$$ = **84.914 feet/second**

Stack gas volumetric flow rate:

$$Q_a = A_s \times V_s \times 60$$ = **324,118 acfm**

Stack gas volumetric flow rate, wet basis:

$$Q_{sw} = Q_a \times \left[\left(\frac{528°R}{29.92in.Hg}\right) \times \left(\frac{P_s}{T_s + 460}\right)\right]$$ = **172,300 scfm**

$$Q_{sw} = Q_a \times \left[\left(\frac{528°R}{29.92in.Hg}\right) \times \left(\frac{P_s}{T_s + 460}\right)\right] \times 60$$ = **10,337,994 scfh**

Stack gas volumetric flow rate, dry basis:

$$Q_{std} = Q_{sw} \times (1 - B_{wo})$$ = **137,867 dscfm**

$$Q_{std} = Q_{sw} \times (1 - B_{wo}) \times 60$$ = **8,272,031 dscfh**

USEPA Method 4
Moisture Determination Sample Calculations

Client:	BP
Location:	Whiting, IN
Source:	FCCU 500
Date:	5/27/2020
Run #:	2-B

Data Input:

Volume metered (V_m):	32.124	**ft^3**
Meter calibration coefficient (Y_d):	1.009	**dimensionless**
Barometric pressure (P_{bar}):	29.29	**inches Hg**
Meter sample rate (ΔH):	0.30	**inches H_2O**
Meter inlet/outlet temperature (T_m):	117.3	**°F**
Volume of moisture collected (V_{lc}):	154.1	**milliliters**
Stack Temperature (T_s):	510.0	**°F**
Static Pressure (St):	-1.0	**inches H_2O**

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Volume of sample, dry basis:

$$Vm_{std} = V_m \times Y_d \times \left(\frac{528.0^\circ R}{29.92"Hg}\right) \times \left(\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m + 460}\right)$$ = **29.043 dscf**

Volume of water vapor in sample:

$$Vw_{std} = \frac{0.04707 ft^3}{ml} \times V_{lc}$$ = **7.253 scf**

Fractional moisture content of stack gas:

$$B_{wo} = \frac{Vw_{std}}{(Vm_{std} + Vw_{std})}$$ = **0.1998 B_{wo}**

Percent Moisture:

$$\%moisture = B_{wo} \times 100$$ = **19.98 %**

Fractional moisture content of stack gas at saturated conditions:

$$T_{s(°K)} = ((T_s - 32) * 0.5556) + 273$$ = **538.6 °Kelvin**

$$P_{s(mmHg)} = \left(P_{bar} + \frac{S_t}{13.6}\right) \times 25.401$$ = **744.00 mm Hg**

$$B_{wos} = \frac{\sqrt{\left(10^{\left(A - \left(\frac{B}{(T_{s(°K)} - C)}\right)\right)}\right)}}{P_{s(mmHg)}}$$

where:
A= 8.361
B=1893.5
C=27.65

= **1.00**

Percent moisture at saturated conditions:

$$\%moisture_{saturated} = B_{wos} \times 100$$ = **100.00 %**

Percent moisture used for emissions calculations:

= **19.98 %**

USEPA Method 201A PM_{10} Emissions
D_{50} Cutpoint Calculation Summary

Client: BP
Location: Whiting, IN
Source: FCCU 500
Date: 5/27/2020
Run #: 2-B

Data Input

Stack temperature (T_s):	510.0	**°F**
Fractional Moisture content (B_{ws}):	0.1998	
Oxygen (O_2):	1.7	**%**
Stack pressure (P_s):	29.22	**Inches Hg Abs.**
Volume metered (Vm_{std}):	29.043	**dscf**
Volume of water vapor (Vw_{std}):	7.253	**scf**
Molecular weight of gas, wet basis (M_s):	28.488	**lb/lb-mole**
Test length (θ):	93.30	**minutes**
D_p:	10.0	**microns**

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Stack gas viscosity:

$$\mu = -150.3162 + \left(13.4622 \times \sqrt{(T_s + 460)}\right) + \left(3.86153 \times 10^{6} \times (T_s + 460)^{-2}\right) + \left(0.591123 \times (\%O_{2,\,wet})\right) - (91.9723 \times B_{ws}) + \left(1.51761 \times 10^{-5} \times B_{ws} \times (T_s + 460)^{2}\right)$$

= **258.3 micropoise**

Sample flow rate @ standard conditions:

$$Q_{sSt} = \frac{V_{mstd}}{\theta}$$

= **0.311 dscfm**

Sample flow rate through PM_{10} cyclone:

$$Q_s = \frac{29.92}{528} \times Q_{sSt} \times \left(\frac{1}{(1 - B_{ws})}\right) \times \left(\frac{[T_s + 460]}{P_s}\right)$$

= **0.732 cfm**

Calculated Reynolds Number

$$N_{re} = 8.64 \times 10^{5} \times \left(\frac{P_s \times M_s}{(T_s + 460)}\right) \times \left(\frac{Q_s}{\mu}\right)$$

= **2100**

Cunningham Correction Factor

$$C = 1 + 0.0057193 \times \left(\frac{\mu}{P_s \times D_p}\right) \times \left(\left(\frac{[T_s + 460]}{M_s}\right)^{0.50}\right)$$

= **1.030**

D_{50} cutpoint (for Cyclone I):

$$D_{50} = \left(0.15625 \times \left(\frac{[T_s + 460]}{(M_s \times P_s)}\right)^{0.2091}\right) \times \left(\frac{\mu}{Q_s}\right)^{.7091}$$

= **10.336 μm**

USEPA Method 202
Condensible Particulate Calculation Summary

COMPANY: BP
LOCATION: Whiting, IN
SOURCE: FCCU 500
TEST DATE: 5/27/20
RUN NUMBER: 2-B

Data Input:

V_m:	32.124	ft^3	Q_s:	137,867	dscfm
γ FACTOR:	1.009		T_s:	510.0	°F
P_{bar}:	29.29	in.Hg	Runtime:	93.30	minutes
ΔH:	0.30	$in.H_2O$	V_s:	84.914	ft/sec
T_m:	117.3	°F	P_s:	29.22	in.Hg
V_{lc}:	154.1	mL	Noz. diam:	0.164	inches
N:	0.0000		m_{ib}:	0.00	mg
V_t:	0.00	mL	m_{ob}:	0.00	mg
m_r:	5.40	mg			
m_o:	0.90	mg			

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Volume of sample at standard conditions:

$$V_{mstd} = \left(\frac{528}{29.92}\right) \times V_m \times \gamma \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}\right] = 29.043 \text{ dscf}$$

Mass of ammonia correction:

$$m_c = 17.03 \times V_T \times N = 0.00 \text{ mg}$$

Mass of the field blank:

$$m_{fb} = m_{ib} + m_{ob} = 0.00 \text{ mg}$$

Mass of inorganic condensible PM:

$$m_i = m_r - m_c = 5.40 \text{ mg}$$

Total mass of condensible PM:

$$m_{cpm} = m_i + m_o - m_{fb} = 6.30 \text{ mg}$$

USEPA Method 201A PM10 Emissions
Particulate Calculation Summary

Client:	BP
Location:	Whiting, IN
Source:	FCCU 500
Date:	5/27/2020
Run #:	2-B

Data Input

Barometric pressure (P_{bar}):	29.29 **inches Hg**	**Particulate Weight:**	
Stack pressure (P_s):	29.22 **Inches Hg Abs.**	**<PM10 (Filterable)**	79.50 **milligrams**
Test length (θ):	93.30 **minutes**	**>PM10 (Cyclone Catch)**	28.60 **milligrams**
Sample nozzle diameter (D_n):	0.1640 **inches**		
Sample nozzle area (A_n):	0.000147 **ft²**	**<PM10 (Probe Wash)**	4.05 **milligrams**
Stack temperature (T_s):	510.0 **°F**	**Total PM_{10} front half:**	83.55 **milligrams**
Volume metered (Vm_{std}):	29.043 **ft³**		
Stack gas velocity (V_s):	84.914 **feet/second**	**Total PM front half**	112.15 **milligrams**
Stack gas volumetric flow (Q_{std}):	8,272,031 **dsct/hour**	**Total corrected PM_{10} back half:**	6.30 **milligrams**
Fractional Moisture content (B_{wo}):	0.1998		
Coke Burn Rate (R_c):	35,986 **lb/hr**	**Total PM_{10} weight (M_n):**	89.85 **milligrams**
		Total PM weight (M_n):	118.45 **milligrams (>PM_{10} + PM_{10})**

Sample calculations @ standard conditions (29.92 inches Hg, 68.0 °F):

Percent Isokinetic:

$$\%\text{Isokinetic} = \frac{0.0945 \times Vm_{std} \times (T_s + 460)}{P_s \times V_s \times \theta \times A_n \times (1 - B_{wo})}$$

= **98.0 % isokinetic**

PM_{10} and Total Particulate emission rate (lb/dscf):

$$C_s = \frac{\left(\frac{0.01543\,\text{grains}}{\text{mg}} \times M_n\right)}{V_{mstd}}$$

= **0.0629 total PM gr/dscf**
= **0.0162 >PM_{10} gr/dscf**
= **0.0444 filterable PM_{10} gr/dscf**
= **0.0033 condensible PM_{10} gr/dscf**
= **0.0477 PM_{10} gr/dscf**

$$C_s = \frac{M_n}{V_{mstd}} \times \frac{35.315\,\text{ft}^3}{\text{m}^3}$$

= **144.032 total PM mg/dscm**
= **34.777 >PM_{10} mg/dscm**
= **101.594 filterable PM_{10} mg/dscm**
= **7.661 condensible PM_{10} mg/dscm**
= **109.256 PM_{10} mg/dscm**

$$E_p = \frac{\left(\frac{2.205 \times 10^{-6}\,\text{lb}}{\text{mg}} \times M_n\right)}{V_{mstd}}$$

= **8.993 x 10^{-6} total PM lb/dscf**
= **2.171 x 10^{-6} >PM_{10} lb/dscf**
= **6.343 x 10^{-6} filterable PM_{10} lb/dscf**
= **0.478 x 10^{-6} condensible PM_{10} lb/dscf**
= **6.822 x 10^{-6} PM_{10} lb/dscf**

PM_{10} and Total Particulate emission rate (lb/hr):

$$E_p = C^1_s \times Q_{std}$$

= **74.391 total PM lb/hr**
= **17.962 >PM_{10} lb/hr**
= **52.472 filterable PM_{10} lb/hr**
= **3.957 condensible PM_{10} lb/hr**
= **56.429 PM_{10} lb/hr**

$$pmr_{lb/1000\,lb\,coke\,burn} = \frac{(E_p)(1000)}{(R_c)}$$

= **2.067 total PM lb/1000lb coke burn**
= **0.499 >PM_{10} lb/1000lb coke burn**
= **1.458 filterable PM_{10} lb/1000lb coke burn**
= **0.110 condensible PM_{10} lb/1000 coke burn**
= **1.568 PM_{10} lb/1000 coke burn**

ATTACHMENT B
FIELD DATA

MONTROSE AIR QUALITY SERVICES

USEPA Method 201A Field Datasheet (Isokinetic)

Page 1 of 2

M024AS-748176-RT-589

29 of 46

Project Information		Sampling Conditions		ALT 011	TC ID:	Ambient °F	Ref. °F
Date 5/27/20	Project # 024AS-748176	Static Pressure, in. H_2O -1.0	Ambient Temp, °F 90	Stack			
Customer/Facility BP WHITING		Barometric Pressure, in. Hg 29.24	Ref. Barometer ID T-8	Probe			
Unit ID/Sample Location FCCU 500		Wind Speed / Direction	Precipitation, Y / N Type	Filter Box			
Run # 1A	Operator MK, JL	Probe / Filter Temp Range, °F ± 24	248 ± 25	Filter Exit			
				Meter outlet			
				Impinger Exit			
				Other			
				Ref. Thermometer ID			
				Continuity Check ☐ Continuity w/ Proper Polarity			

Sampling Equipment IDs		Calibration		Equipment Checks	Pre	Mid	Post
Meterbox ID	611209	Meterbox Y	.995	Pitot (+), pass @ in. H_2O	☑ @ 4.6	☐ @	☑ @ 5.1
Umbilical ID	32	Meterbox ΔH@, in. H_2O	1.841	Pitot (-), pass @ in. H_2O	☑ @ 5.3	☐ @	☐ @ 4.9
Nozzle ID	3	Nozzle diameter, Dn, in.	.164	Pitot visual inspection	☑ pass	☐ pass	☑ pass
Pitot / Probe ID	5067	Pitot coefficient, Cp	.84	Nozzle visual inspection	☑ pass	☐ pass	☑ pass
Manometer ID	611209	Manometer zero and level	☑ yes	Meter, cfm @ in. Hg	0.000 @ 15	@	0.000 @ 6
Sensitivity	0.0-.001	K-Factor	9.47	Intermediate leak check volume, ft^3	/	/	/

Notes: @ MTA
549.945 IS START VOLUME

Traverse Point #	Elapsed Time	Clock Time 24hr	DGM Reading, V_m, ft^3	Velocity Head, ΔP in H_2O	Orifice Pressure Differential, ΔH Target	Orifice Pressure Differential, ΔH Actual	Stack Temp, °F	Probe Temp, °F	Filter Temp, °F Box	Filter Temp, °F Exit	Impinger Exit Temp, °F	Dry Gas Meter Temperature, °F Inlet	Dry Gas Meter Temperature, °F Outlet	ΔH	Pump Vacuum, in. Hg
A 1	0	0950	549.945 ~~549.945~~ 549.735	1.1	.35	.35	510	257	256	225	63	98	91	69	3
1	9:56	0900	553.260	1.1	.35	.35	511	257	258	236	58	101	92	68	3
1	19:52	0910	556.66	1.2	.35	.35	510	256	264	230	58	104	91	69	3
1	30:14	0920	559.98	1.1	.35	.35	512	261	259	232	60	104	92	71	3
1	40:18	0936	563.25	1.1	.35	.35	510	258	256	235	60	107	91	73	3
1	50:06	0940	566.51	1.1	.35	.35	511	255	257	236	61	111	93	74	3
1	60:02	0950	569.74	1.1	.35	.35	512	256	257	230	63	113	93	76	3
1	69:58	1000	572.96	1.2	.35	.35	510	256	255	238	65	114	94	78	3
1	80:10	1010	576.92	1.2	.35	.35	511	255	256	236	65	119	95	78	3
1	90:32	1020	579.61	1.1	.35	.35	512	260	255	232	65	114	96	75	3
1	100:28	1030	582.85	1.1	.35	.35	510	248	250	235	62	115	97	73	3
1	110:24	1040	586.11	1.1	.35	.35	512	247	251	238	63	114	97	74	3
	120:20	1050	589.350												
Averages			MTK 39.405	MTK 1.0605		MTK .35	MTK 510.9					MTA 101.5			

QA/QC Check: Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Checked By MK KROEGER Team Leader

MONTROSE AIR QUALITY SERVICES

K-Factor 9.47 ΔH 0.34 0.33

EPA Method 201A/202 Field Datasheet (Isokinetic) Train 1B F 28170

Page 1B of 2B

Project Information		Sampling Conditions		ALT 011	TC ID:	Ambient °F	Ref. °F
Date 5/27/20	Project # 024AB-748176	Static Pressure, in. H_2O -0.85	Ambient Temp, °F 90	Stack			
Customer/Facility BP Whiting		Barometric Pressure, in. Hg 29.29	Ref. Barometer ID T-8	Probe			
Unit ID/Sample Location FCCU 500		Wind Speed / Direction	Precipitation, Y (N), type	Filter Box			
Run # 1B	Operator	Probe / Filter Temp Range, °F 248 ± 25		Filter Exit			

Sampling Equipment IDs		Calibration		Equipment Checks	Pre	Mid	Post
Meterbox ID	604178	Meterbox Y	1.009	Pitot (+), pass @ in. H_2O	☑ @ 3.5	☐ @	☑ @ 4.6
Umbilical ID	50	Meterbox ΔH@, in. H_2O	1.606	Pitot (-), pass @ in. H_2O	☑ @ 4.5	☐ @	☑ @ 4.0
Nozzle ID	3	Nozzle diameter, Dn, in.	.164	Pitot visual inspection	☑ pass	☑ pass	☑ pass
Pitot / Probe ID	5066	Pitot coefficient, Cp	.84	Nozzle visual inspection	☑ pass	☐ pass	☐ pass
Manometer ID	604178	Manometer zero and level	☑ yes	Meter, cfm @ in. Hg	0.001 @ 15	@	0.00 @ 4
Sensitivity	0.0-0.00	K-Factor	9.47	Intermediate leak check volume, ft^3		/	/

Meter outlet

Impinger Exit

Other

Ref. Thermometer ID

Continuity Check ☐ Continuity w/ Proper Polarity

Notes:

Traverse Point #	Elapsed Time	Clock Time 24hr	DGM Reading, Vm, ft^3	Velocity Head, ΔP in H_2O	Orifice Pressure Differential, ΔH Target	Orifice Pressure Differential, ΔH Actual	Stack Temp, °F	Probe Temp, °F	Filter Temp, °F Box	Filter Temp, °F Exit	Impinger Exit Temp, °F	Dry Gas Meter Temperature, °F Inlet	Dry Gas Meter Temperature, °F Outlet	CPM 65.35	Pump Vacuum, in. Hg
1	0	09:50	148.789	1.1	0.32	0.32	510	249	260	258	67	99	93	75	4
1	9.56	09:00	152.330	1.2			510	246	257	257	65	108	90	76	4
1	20.17	09:10	155.915	1.2			510	246	257	256	67	108	91	77	4
1	30.40	09:20	159.530	1.2			510	251	257	257	63	113	91	78	3
1	41.02	09:21	163.070	1.2			510	247	257	257	63	111	91	78	4
1	51.58	09:31	166.705	1.2			510	247	258	257	63	118	94	77	4
1	62.20	09:[illegible]	170.335	1.2			510	248	258	258	64	120	97	84	4
1	72.42	10:02	173.92	1.2			510	247	259	258	62	121	99	80	4
1	83.04	10:13	177.50	1.1			510	248	258	259	67	121	100	84	4
1	93.00	10:23	180.93	1.1			510	248	258	258	60	121	100	79	3
1	102.56	10:32	184.49	1.1			510	248	258	258	59	121	100	79	3
1	112.52	10:42	187.85	1.1			510	248	258	258	59	121	101	77	3
	122.48	1052	191.295												
Averages			42.506	√1.0760	0.32	0.32	510.0				≤67	114.9	95.6		≤4

105.3

QA/QC Check: Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Checked By [illegible] Team Leader

001AS-QMS-FM-225

MONTROSE AIR QUALITY SERVICES

US EPA Method 201A Field Datasheet (isokinetic) 281 Zy

Project Information
Date 5/27/20 Project # 024AS-748176
Customer/Facility BP Whiting
Unit ID/Sample Location FCCU 500
Run # 2A Operator UL/MK

Sampling Conditions
Static Pressure, in. H_2O -1.0 Ambient Temp, °F 83
Barometric Pressure, in. Hg 29.29 Ref. Barometer ID T-8
Wind Speed / Direction Precipitation, Y/(N) type
Probe / Filter Temp Range, °F 248 ± 25

ALT 011	TC ID:	Ambient °F	Ref. °F
Stack			
Probe			
Filter Box			
Filter Exit			
Meter outlet			
Impinger Exit			
Other -			

Ref. Thermometer ID
Continuity Check ☐ Continuity w/ Proper Polarity
Notes: * MTK 5/29

Sampling Equipment IDs
Meterbox ID 611209
Umbilical ID 32
Nozzle ID 3
Pitot / Probe ID 5067
Manometer ID 611209
Sensitivity 0.0 - .001

Calibration
Meterbox Y 0.995
Meterbox ΔH@, in. H_2O 1.841
Nozzle diameter, Dn, in. .164
Pitot coefficient, Cp .84
Manometer zero and level ☑ yes
K-Factor 9.47

Equipment Checks	Pre	Mid	Post
Pitot (+), pass @ in. H_2O	☑ @ 4.6	☐ @	☑ @ 5.3
Pitot (-), pass @ in. H_2O	☑ @ 5.2	☐ @	☑ @ 4.9
Pitot visual inspection	☑ pass	☐ pass	☑ pass
Nozzle visual inspection	☑ pass	☐ pass	☑ pass
Meter, cfm @ in. Hg	0.000 @ 15	@	0.000 @ 5
Intermediate leak check volume, ft³		/	/

Traverse Point #	Elapsed Time	Clock Time 24hr	DGM Reading, Vm, ft³	Velocity Head, ΔP in H_2O	Orifice Pressure Differential, ΔH Target	Orifice Pressure Differential, ΔH Actual	Stack Temp, °F	Probe Temp, °F	Filter Temp, °F Box	Filter Temp, °F Exit	Impinger Exit Temp, °F	Dry Gas Meter Temperature, °F Inlet	Dry Gas Meter Temperature, °F Outlet	Aux.	Pump Vacuum, in. Hg
A-1	0	12:17	589.710	1.1	3.7	03.7	511	251	237	232	65	111	86	74	3
1	09:56	1227	592.810	1.1	3.7	3.7	514	253	241	236	65	111	88	75	3
1	19:52	1237	596.10	1.2	3.7	3.7	514	254	241	234	66	111	89	75	3
1	30:14	1247	599.56	1.2	3.7	3.7	514	252	242	238	65	112	90	77	4
1	40:36	1257	603.10	1.2	3.7	3.7	514	253	243	235	65	113	91	78	4
1	50:58	1307	606.46	1.1	3.7	3.7	514	257	242	237	64	113	92	79	4
1	60:54	1317	609.80	1.1	3.7	3.7	514	255	242	236	63	115	93	78	4
1	70:50	1327	613.15	1.1	3.7	3.7	514	257	241	235	63	113	93	76	4
1	80:46	1337	616.54	1.1	3.7	3.7	513	258	238	232	62	116	92	76	4
	90:42	1347	619.890												
Averages			30.180	1.0644		0.37	513.6 (~~513.5~~) MTK					101.6			3.6

QA/QC Check: Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Checked By M. KRUEGER Team Leader

001AS-QMS-FM-225

MONTROSE AIR QUALITY SERVICES

EPA ____ Method 201A/202 Field Datasheet (Isokinetic) 2B

M024AS-748176-RT-589

Project Information

Date 5/27/20 Project # 024AS-748176

Customer/Facility BP Whiting

Unit ID/Sample Location FCCU 500

Run # 2B Operator VK

Sampling Conditions

Static Pressure, in. H_2O -0.95 Ambient Temp, °F 91

Barometric Pressure, in. Hg 29.29 Ref. Barometer ID T-8

Wind Speed / Direction ____ Precipitation, Y / (N), type ____

Probe / Filter Temp Range, °F 248 ± 25

ALT 011	TC ID:	Ambient °F	Ref. °F
Stack			
Probe			
Filter Box			
Filter Exit			
Meter outlet			
Impinger Exit			
Other			

Ref. Thermometer ID ____

Continuity Check ☐ Continuity w/ Proper Polarity

Notes: # MFR 5/27

Sampling Equipment IDs

Meterbox ID 604178

Umbilical ID 50

Nozzle ID 3

Pitot / Probe ID 5066

Manometer ID 604178

Sensitivity ____

Calibration

Meterbox Y 1.009

Meterbox ΔH@, in. H_2O 1.606

Nozzle diameter, Dn, in. .164

Pitot coefficient, Cp 0.84

Manometer zero and level ☑ yes

K-Factor 9.47

Equipment Checks

	Pre	Mid	Post
Pitot (+), pass @ in. H_2O	☑ @ 4.6	☐ @	☐ @ 4.0
Pitot (-), pass @ in. H_2O	☑ @ 5.0	☐ @	☐ @ 4.0
Pitot visual inspection	☑ pass	☐ pass	☑ pass
Nozzle visual inspection	☐ pass	☐ pass	☐ pass
Meter, cfm @ in. Hg	0.001 @ 15	@	0.00 @ 3
Intermediate leak check volume, ft^3	/	/	/

Traverse Point #	Elapsed Time	Clock Time 24hr	DGM Reading, Vm, ft^3	Velocity Head, ΔP in H_2O	Orifice Pressure Differential, ΔH Target	Orifice Pressure Differential, ΔH Actual	Stack Temp, °F	Probe Temp, °F	Filter Temp, °F Box	Filter Temp, °F Exit	Impinger Exit Temp, °F	Dry Gas Meter Temperature, °F Inlet	Dry Gas Meter Temperature, °F Outlet	cpm	Pump Vacuum, in. Hg
1	0	1217	193.176	1.2	0.30	0.30	510	243	259	259	68	124	103	75	3
1	10.22	1227	196.98	1.2	.30	.30	510	243	259	258	68	126	104	80	3
1	20.44	1237	200.57	1.2	.30	.30	510	243	259	259	68	128	105	82	3
1	31.06	1248	204.09	1.2	.30	.30	510	248	260	259	63	128	107	78	3
1	41.28	1258	207.69	1.2	.30	.30	510	243	258	256	61	128	107	79	3
1	51.50	1308	211.24	1.2	.30	.30	510	244	258	258	60	128	108	78	3
1	62.12	1319	214.78	1.2	.30	.30	510	240	257	259	60	129	109	80	3
1	72.34	1329	218.29	1.2	.30	.30	510	244	259	259	62	129	109	82	3
1	82.56	1339	221.78	1.2	.30	.30	510	244	259	258	62	129	110	82	3
	93.18	1350	225.270												
Averages			32.124	1.0954	.30		510.0				63.8	~~127.6~~	~~106.8~~		3

QA/QC Check: Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Checked By Van Why Team Leader ____

117.3

MONTROSE AIR QUALITY SERVICES

Sample Recovery & Calibration Check Datasheet

Project Information

Date: 5/27/20 Project #: 02AS-748176
Customer / Facility: BP WHITE NO
Unit ID / Sample Location: FCCU 500
Run #: 1A-2A / 1B-2B Operator: MK/JC/SF

Equipment Identification

Ref. Thermometer:
Hygrometer:
Field Balance: T-8
Check Weights: T-8
Calipers: M13

Balance Audit (Field balance must be within 0.5g of check weight mass)

Date	5/27/20		
Standard mass, g	500.0		
Field balance mass, g	499.9		

Ambient Conditions (Mobile Lab)

Relative humidity, %:
Temperature, °F: 80
Mobile lab #: T-8

Moisture Determination

	Contents	Run1 (1A) Initial	Run1 (1A) Final	Run1 (1A) Net	Run 2 (1B) Initial	Run 2 (1B) Final	Run 2 (1B) Net	Run 3 (2A) Initial	Run 3 (2A) Final	Run 3 (2A) Net
Knockout	N/A	394.2	571.5	177.3	392.8	561.3	168.5	379.3	508.5	~~142.~~ 129.2
Impinger 1	N/A	676.8	678.6	1.8	673.2	693.2	20.0	667.9	669.7	1.8
Impinger 2	H_2O	739.4	742.4	2.5	756.0	761.0	4.8	720.1	722.4	2.3
Impinger 3	S.G	809.8	823.3	13.5	886.4	904.8	18.4	842.3	851.3	9.0
Impinger 4										
Impinger 5										
Impinger 6										
Impinger 7										
Impinger 8										
Silica Gel										
Line Rinse										
Train Net Gain (Vlc)				195.1			211.7			142.3

Nozzle Measurements (Difference between any two measurements must not be more than 0.004 in (0.1 mm))

Nozzle 1 diameters: 0.164 D1 0.164 D2 0.164 D3 0.164 Average A
Nozzle 2 diameters: 0.164 D1 0.164 D2 0.164 D3 0.164 Average B
Nozzle 3 diameters: D1 D2 D3 Average

Nozzle Material ☐ quartz ☐ glass ☒ steel ☐ titanium ☐ inconel ☐ other
Probe Type ☒ heated ☐ unheated ☐ air-cooled ☐ water-cooled ☐ other
Probe Liner ☐ quartz ☐ glass ☒ steel ☐ Teflon ☐ other

Filter Information

Front Half: ☒ quartz fiber ☐ glass fiber ☐ Teflon ☐ Teflon/quartz ☐ other
Filter Number: Run 1: Run 2: Run 3: Run :
Back Half: ☐ quartz fiber ☐ glass fiber ☐ Teflon ☐ Teflon/quartz ☐ other

Reagent Information

Type	Lot Number
ACETONE	0000242182
DI	000023757G
HEXANE	173874

Sample Observations

* MTK 5/28

QA/QC Check: Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓

Checked by: M. KRUEGER Team Leader:

001AS-QMS-FM-226

MONTROSE AIR QUALITY SERVICES

Sample Recovery & Calibration Check Datasheet

Project Information

Date 5/27/20 Project # OLYAS-748176

Customer / Facility BP WH, Texas

Unit ID / Sample Location FCCU 500

Run # 2B Operator MK/JC/SF

Equipment Identification

Ref. Thermometer

Hygrometer

Field Balance T-8

Check Weights T-8

Calipers M13

Balance Audit (Field balance must be within 0.5g of check weight mass)

Date 5/27

Standard mass, g 500.0

Field balance mass, g 499.9

Ambient Conditions (Mobile Lab)

Relative humidity, %

Temperature, °F

Mobile lab # T-8

Moisture Determination 2B

	Contents	Run1 Initial	Run1 Final	Run1 Net	Run 2 Initial	Run 2 Final	Run 2 Net	Run 3 Initial	Run 3 Final	Run 3 Net
Knockout	MK	371.8	508.9	137.1						
Impinger 1	MT	803	804.0	2.7						
Impinger 2	DI	684.0	685.1	1.1						
Impinger 3	SG	200.0	213.2	13.2						
Impinger 4										
Impinger 5										
Impinger 6										
Impinger 7										
Impinger 8										
Silica Gel										
Line Rinse										
Train Net Gain (Vlc)				154.1						

Nozzle Measurements (Difference between any two measurements must not be more than 0.004 in (0.1 mm))

Nozzle 1 diameters ____ D1 ____ D2 ____ D3 ____ Average

Nozzle 2 diameters ____ D1 ____ D2 ____ D3 ____ Average

Nozzle 3 diameters ____ D1 ____ D2 ____ D3 ____ Average

Nozzle Material ☐ quartz ☐ glass ☐ steel ☐ titanium ☐ inconel ☐ other ____

Probe Type ☐ heated ☐ unheated ☐ air-cooled ☐ water-cooled ☐ other ____

Probe Liner ☐ quartz ☐ glass ☐ steel ☐ Teflon ☐ other ____

Filter Information

Front Half: ☐ quartz fiber ☐ glass fiber ☐ Teflon ☐ Teflon/quartz ☐ other ____

Filter Number: Run 1: ____ Run 2: ____ Run 3: ____ Run ___: ____

Back Half: ☐ quartz fiber ☐ glass fiber ☐ Teflon ☐ Teflon/quartz ☐ other ____

Reagent Information	
Type	**Lot Number**

Sample Observations

QA/QC Check: Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓

Checked by: M. KRUEGER Team Leader: ____

001AS-QMS-FM-226

ATTACHMENT C
LABORATORY DATA

ANALYTICAL SUMMARY

CLIENT: BP
LOCATION: Whiting, IN
SOURCE: FCU 500
SAMPLE DATE: 5/27/2020
ANALYSIS: Particulates
METHOD: USEPA Method 201/202

Analyst: J. Ruggaber
Date of Completion: 6/5/2020
Template Control ID: USEPA-M201/202-PARTIC-TEMPLATE-62T-REV3
Project Number: 08-1414

Method 201A Filterable PM

Identification	LIMS Number	Solvent Mass (g)	Tare	WT1	WT2	WT 1 - WT 2 (mg)	% difference	Particulate (mg)	Blank Corrected Particulate (mg)
Run 1A Filter	30320	-	825.2	938.7	938.8	-0.10	N/A	113.55	-
Run 1A >PM10	30315	31.1	3584.4	3619.2	3619.1	0.10	N/A	34.75	34.75
Run 1A ≤ 10PM	30316	168.1	3620.0	3633.8	3633.5	0.30	N/A	13.65	13.65
Run 1B Filter	30326	-	824.7	943.2	943.2	0.00	N/A	118.50	-
Run 1B >PM10	30321	36.4	3731.5	3767.9	3768.0	-0.10	N/A	36.45	36.45
Run 1B ≤ 10PM	30322	96.6	3946.3	3957.3	3957.5	-0.20	N/A	11.10	11.10
Run 2A Filter	30333	-	823.7	907.4	907.6	-0.20	N/A	83.80	-
Run 2A >PM10	30328	28.8	3956.3	3978.6	3978.6	0.00	N/A	22.30	22.30
Run 2A ≤ 10PM	30329	103.1	3929.1	3934.4	3934.1	0.30	N/A	5.15	5.15
Run 2B Filter	30339	-	835.8	915.3	915.3	0.00	N/A	79.50	-
Run 2B >PM10	30334	31.7	3847.3	3875.8	3876.0	-0.20	N/A	28.60	28.60
Run 2B ≤ 10PM	30335	83.8	3874.9	3878.9	3879.0	-0.10	N/A	4.05	4.05
Acetone Blank	30340	78.1	3793.8	3793.7	3793.7	0.00	N/A	<0.10	-

M202 Organic Fraction

Identification	LIMS Number	Tare	WT1	WT2	WT 1 - WT 2 (mg)	% difference	Organic CPM (mg)
Run 1A	30318	3910.6	3912.2	3912.2	0.00	N/A	1.60
Run 1B	30324	3791.3	3792.8	3792.8	0.00	N/A	1.50
Run 2A	30331	3928.0	3928.7	3928.9	-0.20	N/A	0.80
Run 2B	30337	3778.4	3779.2	3779.4	-0.20	N/A	0.90
Acetone Blank	30341	3547.6	3547.5	3547.6	-0.10	N/A	<0.10
Hexane Blank	30327	3611.3	3611.3	3611.2	0.10	N/A	<0.10

MONTROSE AIR QUALITY SERVICES

ANALYTICAL SUMMARY

CLIENT: BP
LOCATION: Whiting, IN
SOURCE: FCU 500
SAMPLE DATE: 5/27/2020
ANALYSIS: Particulates
METHOD: USEPA Method 201/202

Analyst: J. Ruggaber
Date of Completion: 6/5/2020
Template Control ID: USEPA-M201/202-PARTIC-TEMPLATE-62T-REV3
Project Number: 08-1414

M202 Aqueous Fraction

Identification	LIMS Number	Tare	WT1	WT2	WT 1 - WT 2 (mg)	% difference	Inorganic CPM (mg)
Run 1A	30317	3489.9	3496.6	3496.8	-0.20	N/A	6.80
Run 1B	30323	3804.9	3814.1	3814.4	-0.30	N/A	9.35
Run 2A	30330	3919.0	3923.6	3923.8	-0.20	N/A	4.70
Run 2B	30336	3820.3	3825.6	3825.8	-0.20	N/A	5.40
DI Water Blank	30342	3562.9	3563.1	3563.1	0.00	N/A	0.20

MONTROSE
AIR QUALITY SERVICES
951 Old Rand Road # 106
Wauconda, IL 60084

Montrose Air Quality Services Analytical Report

BP-Whiting
Whiting, IN
FCU-500

Lab Project #: 08-1414
Project Manager: Steve Flaherty
Received: 5/29/2020
Reported: 6/5/2020

Sample ID: 1-A >PM10
Lab Sample #: 30315
Date Sampled: 05/27/2020
Field #: 32062

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Particulate	Method 201A	Joel Ruggaber	06/05/2020	34.75	mg	

Sample ID: 1-A PW
Lab Sample #: 30316
Date Sampled: 05/27/2020
Field #: 32063

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Particulate	Method 201A	Joel Ruggaber	06/05/2020	13.65	mg	

Sample ID: 1-A Imps
Lab Sample #: 30317
Date Sampled: 05/27/2020
Field #: 32064

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Inorganic Residue	USEPA Method 202	Joel Ruggaber	06/05/2020	6.80	mg	

Sample ID: 1-A Organics
Lab Sample #: 30318
Date Sampled: 05/27/2020
Field #: 32065

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Organic Residue	USEPA Method 202	Joel Ruggaber	06/05/2020	1.60	mg	

Sample ID: 1-A CPM Filter
Lab Sample #: 30319
Date Sampled: 05/27/2020
Field #: 32066

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes

Sample ID: 1-A Filter
Lab Sample #: 30320
Date Sampled: 05/27/2020
Field #: 31769

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes

MONTROSE
AIR QUALITY SERVICES
951 Old Rand Road # 106
Wauconda, IL 60084

Montrose Air Quality Services Analytical Report

BP-Whiting
Whiting, IN
FCU-500

Lab Project #: 08-1414
Project Manager: Steve Flaherty
Received: 5/29/2020
Reported: 6/5/2020

Particulate	Method 201A	Joel Ruggaber	06/05/2020	113.55	mg

Sample ID: 1-B >PM10
Lab Sample #: 30321
Date Sampled: 05/27/2020
Field #: 32067

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Particulate	Method 201A	Joel Ruggaber	06/05/2020	36.45	mg	

Sample ID: 1-B PW
Lab Sample #: 30322
Date Sampled: 05/27/2020
Field #: 32083

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Particulate	Method 201A	Joel Ruggaber	06/05/2020	11.10	mg	

Sample ID: 1-B Imps
Lab Sample #: 30323
Date Sampled: 05/27/2020
Field #: 32069

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Inorganic Residue	USEPA Method 202	Joel Ruggaber	06/05/2020	9.35	mg	

Sample ID: 1-B Organics
Lab Sample #: 30324
Date Sampled: 05/27/2020
Field #: 32070

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Organic Residue	USEPA Method 202	Joel Ruggaber	06/05/2020	1.50	mg	

Sample ID: 1-B CPM Filter
Lab Sample #: 30325
Date Sampled: 05/27/2020
Field #: 32081

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes

Sample ID: 1-B Filter
Lab Sample #: 30326
Date Sampled: 05/27/2020
Field #: 28175

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes

MONTROSE
AIR QUALITY SERVICES

951 Old Rand Road # 106
Wauconda, IL 60084

Montrose Air Quality Services Analytical Report

BP-Whiting
Whiting, IN
FCU-500

Lab Project #: 08-1414
Project Manager: Steve Flaherty
Received: 5/29/2020
Reported: 6/5/2020

Particulate	Method 201A	Joel Ruggaber	06/05/2020	118.50	mg

Sample ID: Hexane Blank
Lab Sample #: **30327**
Date Sampled: 05/27/2020
Field #: 32087

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Organic Residue	USEPA Method 202	Joel Ruggaber	06/05/2020	<0.10	mg	

Sample ID: 2-A >PM10
Lab Sample #: **30328**
Date Sampled: 05/27/2020
Field #: 32082

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Particulate	Method 201A	Joel Ruggaber	06/05/2020	22.30	mg	

Sample ID: 2-A PW
Lab Sample #: **30329**
Date Sampled: 05/27/2020
Field #: 32083

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Particulate	Method 201A	Joel Ruggaber	06/05/2020	5.15	mg	

Sample ID: 2-A Imps
Lab Sample #: **30330**
Date Sampled: 05/27/2020
Field #: 32061

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Inorganic Residue	USEPA Method 202	Joel Ruggaber	06/05/2020	4.70	mg	

Sample ID: 2-A Organics
Lab Sample #: **30331**
Date Sampled: 05/27/2020
Field #: 32084

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Organic Residue	USEPA Method 202	Joel Ruggaber	06/05/2020	0.80	mg	

Sample ID: 2-A CPM Filter
Lab Sample #: **30332**
Date Sampled: 05/27/2020
Field #: 32071

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes

MONTROSE
AIR QUALITY SERVICES

951 Old Rand Road # 106
Wauconda, IL 60084

Montrose Air Quality Services Analytical Report

BP-Whiting
Whiting, IN
FCU-500

Lab Project #: 08-1414
Project Manager: Steve Flaherty
Received: 5/29/2020
Reported: 6/5/2020

Sample ID: 2-A Filter
Lab Sample #: 30333
Date Sampled: 05/27/2020
Field #: 28174

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Particulate	Method 201A	Joel Ruggaber	06/05/2020	83.80	mg	

Sample ID: 2-B >PM10
Lab Sample #: 30334
Date Sampled: 05/27/2020
Field #: 32072

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Particulate	Method 201A	Joel Ruggaber	06/05/2020	28.60	mg	

Sample ID: 2-B PW
Lab Sample #: 30335
Date Sampled: 05/27/2020
Field #: 32073

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Particulate	Method 201A	Joel Ruggaber	06/05/2020	4.05	mg	

Sample ID: 2-B Imps
Lab Sample #: 30336
Date Sampled: 05/27/2020
Field #: 32074

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Inorganic Residue	USEPA Method 202	Joel Ruggaber	06/05/2020	5.40	mg	

Sample ID: 2-B Organics
Lab Sample #: 30337
Date Sampled: 05/27/2020
Field #: 32075

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Organic Residue	USEPA Method 202	Joel Ruggaber	06/05/2020	0.90	mg	

Sample ID: 2-B CPM Filter
Lab Sample #: 30338
Date Sampled: 05/27/2020
Field #: 32076

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes

MONTROSE AIR QUALITY SERVICES
951 Old Rand Road # 106
Wauconda, IL 60084

Montrose Air Quality Services Analytical Report

BP-Whiting
Whiting, IN
FCU-500

Lab Project #: 08-1414
Project Manager: Steve Flaherty
Received: 5/29/2020
Reported: 6/5/2020

Sample ID: 2-B Filter
Lab Sample #: 30339
Date Sampled: 05/27/2020
Field #: 28183

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Particulate	Method 201A	Joel Ruggaber	06/05/2020	79.50	mg	

Sample ID: 201A Acetone Blank
Lab Sample #: 30340
Date Sampled: 05/27/2020
Field #: 32086

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Particulate	Method 201A	Joel Ruggaber	06/05/2020	<0.10	mg	

Sample ID: 202 Acetone Blank
Lab Sample #: 30341
Date Sampled: 05/27/2020
Field #: 32088

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Organic Residue	USEPA Method 202	Joel Ruggaber	06/05/2020	<0.10	mg	

Sample ID: DI Water Blank
Lab Sample #: 30342
Date Sampled: 05/27/2020
Field #: 32085

Analyte	Method	Analyst	Analysis Date	Result	Units	Notes
Inorganic Residue	USEPA Method 202	Joel Ruggaber	06/05/2020	0.20	mg	

Notes:
NA - Sample not tested for this analyte.
D - Value calculated from dilution.
J - Value less than the low standard but above the Limit of Detection (LOD).
L - Sample leaked before receipt.
H - Value greater than the high standard.
X - Quality control deficiency or failure observed.\
NR - Value not reported per project manager request

MONTROSE
AIR QUALITY SERVICES

Sample Receipt Checklist

Client Name:	BP
Site Location:	Whiting, IN
Montrose Project Manager:	Steve Flaherty
Sample Collection Date(s):	5/27/20
Chain-of-Custody Number(s):	02936, 02934

Chain-of-Custody Form(s):

Custody release signatures, dates, and times present:	Yes
Preservation code noted:	Yes
Project information clearly identified:	Yes
Sample information clearly identified:	Yes
Analysis request clearly identified:	Yes
Report tier level noted:	Yes

Sample Containers:

Quantity of samples match number on the COC	Yes
Container label ID numbers and descriptions match COC	Yes
All containers received in good condition	Yes
Liquid levels at marked heights on containers	Yes
All container labels are legible	Yes
All sample IDs are unique	Yes
Samples received in correct container type	Yes
Samples received within the required holding time	Yes
Samples received under the required preservation code	Yes
Sample receipt temperature (°F) [ ] Meets applicable method limit	N/A

Non-Conformances and/or Corrective Actions Applied:

All of the criteria for sample acceptance have been met.

Samples Received by: Joel Ruggaber

signature

Date and Time received: 5/29/20 11:00

Form LF0002

MONTROSE
AIR QUALITY SERVICES

Chain of Custody Record Number: 02936

M024-AS-748176-RT-5889

Lab Project No. (Lab use only)	Client Name	Client Location
02-1414	BP	Whiting, IN
MAQS Project Number	**MAQS Test Plan Number**	**MAQS Project Manager**
4AS-748176	NA - Engineering	STEVE FLAHERTY
MAQS Sampler Name	**Laboratory (Wauconda or Pasadena)**	**Subcontracted Laboratory (if applicable)**
F/MK/VL/UK	Wauconda	NA

Engineering or Compliance Test Samples

Label Number	Sample Date	Time of Collection[2]	Sample Identification	Number of Containers	Container Type (Petri, Bottle, Bag, Tube, Summa, Bomb)	Preservation Code	Analysis Request[1]				Comments
							Ultra Mobile	Ultra Mobile			
32062	5-22		1-A >PM10	1	250	1	X				
32063			1-A PW	1	250	1	X				
32064			1-A Trips	1	Vial	1		X			
32065			1-A Organics	1	Amb	1		X			
32066			1-A CPart	1	Amb	1		X			
~~32067~~	2149		1-A Filter	1	Petri	1	X				
32067			1-B >PM10	1	250	1	X				
32068			1-B PW	1	250	1	X				
32069			1-B Trips	1	Vial	1		X			
32070			1-B Organics	1	Amb	1		X			
32071			1-B CPart	1	Amb	1		X			
32075			1-B Filter	1	Petri	1	X				
32074			Hexane Blank	1	250	1		X			

Special Instructions:	(1) Relinquished By	(2) Relinquished By	(3) Relinquished By	SHIPMENT:
	(1) Date / Time 5/23/20 @ 1630	(2) Date / Time 5/28/20 @ 1745	(3) Date / Time	Hand Carry
Date test results needed: 6-12-20	(1) Company Montrose	(2) Company Montrose	(3) Company	FedEx
				UPS
Reporting level: Engineering Compliance	(1) Received By VanKhy	(2) Received By	(3) Received By	Custody Seal Applied
Route results through: FLAHERTY	(1) Date / Time 5/28/2020 1745	(2) Date / Time 5/29/20 1100	(3) Date / Time	Yes / No
Project manager signature:	(1) Company Montrose	(2) Company MAQS	(3) Company	

1 – Analysis request must be confirmed by project manager signature

2 – Time of collection applicable to samples requiring specific holding time limits and/or bag spike recovery determination

Form LF0001

MONTROSE AIR QUALITY SERVICES

Chain of Custody Record Number: 02934

Lab Project No. (Lab use only)	Client Name	Client Location
08-1414	BP	Whiting IN
MAQS Project Number	MAQS Test Plan Number	MAQS Project Manager
MW6-748176	—	Flaherty
MAQS Sampler Name	Laboratory (Wauconda or Pasadena)	Subcontracted Laboratory (if applicable)
FH/JVK/MK	Wauconda	NA
Engineering or Compliance Test Samples		
Engineering		

Label Number	Sample Date	Time of Collection[2]	Sample Identification	Number of Containers	Container Type (Petri, Bottle, Bag, Tube, Summa, Bomb)	Preservation Code	Analysis Request[1]: USEPA M201A	Analysis Request[1]: USEPA M202			Comments
32082	5-27		2-A >PM10	1	250W	1	X				
32083			2-A FW	1	250W	1	X				
32061			2-A Imps	1	Nalgene	1		X			
32084			2-A Organics	1	Amber	1		X			
32071			2-A CPM	1	Amber	1		X			
28174			2-A Filter	1	Petri	1	X				
32072			2-B >PM10	1	250W	1	X				
32073			2-B FW	1	250W	1	X				
32074			2-B Imps	1	Nal	1		X			
32075			2-B Organics	1	Amb	1		X			
32076			2-B CPM	1	Amb	1		X			
28183			2-B Filter	1	Petri	1	X				
32086			201A Acetone Blank	1	250W	1	X				
32088			202 Acetone Blank	1	250W	1		X			
32085	↓		DI H2O Blank	1	250W	1		X			

Preservation Code

1 = Ambient Temp.
2 = 4°C (Ice Packs)
3 = Dry Ice
4 = Other (Noted)

Special Instructions:

Date test results needed: 6-12-20

Reporting level: (Engineering) Compliance

Route results through: FLAHERTY

Project manager signature: [signature]

(1)	(2)	(3)
(1) Relinquished By: [signature]	(2) Relinquished By: [signature]	(3) Relinquished By
(1) Date / Time: 5/27/20 @ 1630	(2) Date / Time: 5/28/20 1200	(3) Date / Time
(1) Company: MONTROSE	(2) Company: Montrose	(3) Company
(1) Received By: [signature]	(2) Received By: [signature]	(3) Received By
(1) Date / Time: 5/27/20 @ 1700	(2) Date / Time: 5/29/20	(3) Date / Time
(1) Company: Montrose	(2) Company: MAQS	(3) Company

SHIPMENT: (Hand Carry) FedEx UPS

Custody Seal Applied: Yes (No)

1 – Analysis request must be confirmed by project manager signature
2 – Time of collection applicable to samples requiring specific holding time limits and/or bag spike recovery determination

Form LE0001

M024AS-748176-RT-589

THIS IS THE LAST PAGE OF THIS DOCUMENT

If you have any questions, please contact one of the following individuals by email or phone.

Name: Mr. Steve Flaherty
Title: Midwest District Manager
Email: sflaherty@montrose-env.com
Phone: 847-487-1580 Ext. 12417

Name: Mr. Daniel E. Fitzgerald
Title: Regional Vice President, Midwest/Northeast
Email: dfitzgerald@montrose-env.com
Phone: 847-487-1580 Ext. 12420